

**State of California**  
**AIR RESOURCES BOARD**

**BOARD MEMBERS**  
**ADVANCE AGENDA**

**Cal/EPA Headquarters Building**  
**1001 I Street**  
**Conference Room 550**  
**Sacramento, California 95814**  
**(916) 445-0753**

**April 29, 2003**  
**9:00 a.m. to 4:00 p.m.**

**Interagency Proposal**

1. "Health Impacts of Ultrafine Particles as a Component of Polluted Air in Vulnerable Populations of Southern California," University of California, Irvine, \$1,591,986, Proposal No. 2526-228

The objective of this study is to examine the effects of ultrafine particulate air pollution on a particularly vulnerable subpopulation, the elderly with existing coronary heart disease (CHD). Many studies have demonstrated an association between increases in ambient PM10 and PM2.5 concentrations and increased hospitalizations due to cardiovascular (CV) symptoms as well as increases in CV-related mortality. Recent research has indicated that exposure to ultrafine particles (particles less than 0.1 microns in diameter) may also be a factor in respiratory and CV disease. However, only a handful of studies have been done and all had limitations in their study protocols, such as single monitors to characterize exposure for entire communities.

This study will fill a major gap in the knowledge about the contribution of ultrafine particles to the better-known PM10 CV health effects. The key improvements over previous research include better estimates of actual exposure to the ultrafine, fine, and coarse components of PM; more complete measures of blood biomarkers of inflammatory and blood clotting-related responses; and intensive periods of monitoring effects of PM component exposures on blood pressure and heartbeat irregularities. This study would be co-funded and co-managed by the South Coast Air Quality Management District.

## **Sole Source Proposal**

2. "Environmental Health Conditions in Portable Classrooms," Research Triangle Institute, \$100,000, Proposal No. 2528-229

The objective of this proposal is to statistically describe and analyze the energy and comfort-related characteristics of portable and traditional classrooms in a statewide, representative sample of public K-12 classrooms. The investigators will use the pertinent data from the main California Portable Classrooms Study, such as that on heating, ventilating and air-conditioning systems (HVAC), natural ventilation, and lighting systems. The investigators will characterize the distribution of building factors that were not analyzed in the main study. They will also characterize the relationships among indoor environmental quality measures and key building performance variables, such as building age, ventilation system type, building ventilation conditions, and noise levels. The California Energy Commission is funding this proposal. The results of this study will be used to improve energy efficiency and indoor environmental quality in California schools through improved design, operation, and maintenance of HVAC systems, lighting, and other building systems in California's schools.

## **Innovative Clean Air Technologies Proposals**

3. Monitoring Technologies Proposals
  - a) "Low-cost, Multicomponent Ambient Air Monitoring Technology," Absolytics LLC, \$135,000
  - b) "Development of a Low-cost Particulate Matter Monitor," University of California, Berkeley and Lawrence Berkeley National Laboratory, \$291,000
  - c) "A Simple, Low-cost Beta Attenuation Monitor (BAM) for Continuous Measurement of PM<sub>2.5</sub> or Ultrafine Particle Concentrations," University of Southern California, \$144,000

The ARB is pursuing the development of new air monitoring instruments via the Innovative Clean Air Technologies (ICAT) grant program. Our ultimate goal is commercial availability of inexpensive, easily-used instruments that can be deployed widely to assess local air quality. The purpose of the ICAT program is to co-fund projects that will end with practical demonstrations of new instruments. The projects are defined by the grant applicants. Grantees' projects can be funded up to 50 percent. Half of the funds for grants will be provided by the California Energy Commission (CEC) via a contract with ARB.

The ARB as well as representatives from the CEC, U.S. EPA, and academia have reviewed 13 proposals for projects to develop and demonstrate new instruments. We invited the proposals after reviewing 69 pre-proposals that we received in response to a general solicitation. On the basis of our reviews, staff has selected three of the proposals to recommend to the Board for new grants.

## **Final Reports**

4. "Environmental Health Conditions in Portable Classrooms," Research Triangle Institute, \$799,878, Contract No. 00-317

The objective of this study is to examine environmental conditions, especially those related to indoor air quality and health risks, in K-12 portable classrooms in California. Investigators first conducted a mail survey of over 1,100 classrooms across the state to obtain data on building design and operation characteristics, the concerns of teachers, and indoor formaldehyde levels. Next, a sample of 201 classrooms was recruited for a field study, and included old and new portables, as well as some traditional classrooms. The investigators measured indoor and outdoor VOCs, aldehydes, PM<sub>2.5</sub>, PM<sub>10</sub>, carbon monoxide, carbon dioxide, and mold. They also measured selected allergens and pollutants in the floor dust of selected classrooms. Questionnaires on building ventilation and maintenance practices were administered to the facility manager, and questionnaires on classroom activities and indoor air quality were administered to teachers. The investigators have characterized indoor pollutant levels, ventilation conditions, noise and lighting levels, and teacher complaints. They have also compared the results between portable and traditional classrooms, and characterized the associations between indoor pollutant levels and various building factors such as age, location, building material types, and ventilation factors. The information obtained in this study will be used, along with other available data and information from stakeholder groups, to identify potential indoor environmental quality problems in classrooms, and to recommend actions to the Governor and Legislature for improving indoor environments in California's schools.

5. "Particulate Air Pollution and Cardiovascular and Cardiopulmonary Morbidity," University of California, Davis, \$199,480, Contract No. 98-304

Excess hospitalization and mortality from respiratory and cardiovascular causes, especially among the elderly, has consistently been associated with particulate matter (PM) and less frequently with other ambient air pollutants. These effects have been seen across a wide range of air pollution concentrations commonly observed in developed nations with air pollution control programs. The mechanisms underlying the PM-mortality and-morbidity associations are largely unknown, and this issue is currently a key research focus. The overall goal of this study, is to define the role of long-term exposure to PM, alone and in combination with other air pollutants, in subclinical and clinical cardiovascular changes and risk of cardiovascular events among participants in the National Heart, Lung, and Blood Institute's Cardiovascular Health Study. Through this project, the investigators sought to enhance understanding of the subclinical effects of air pollution exposures, thereby providing insight to biological mechanisms that may underlie the previously reported associations between community-level measures of particulate air pollution and excess morbidity and mortality from respiratory and cardiovascular disease. Although this study has the potential to provide information on the possible impacts of air pollutants on cardiovascular health as well as information on levels of air pollutants in areas across the United States, the report as written is incomplete and requires major revisions and additional data to be included.

6. "Economic Value of Hospitalizations Associated with Particulate and Ozone Air Pollution," San Diego State University, \$284,080, Contract No. 99-329

Scientific and health research literature has demonstrated significant positive relationships between exposure to particulate matter (PM) and ozone and hospital admissions for respiratory and cardiovascular illnesses. However, monetary valuation estimates for these health effects include only the cost of illness (COI) for the medical treatment and value of patient's time spent in the hospital. The estimates represent an incomplete accounting of the costs of hospitalization. The objective of this research project was to develop comprehensive COI and willingness-to-pay (WTP) estimates for economic value of reducing hospitalizations and post-hospitalization clinic visits due to respiratory and cardiovascular illnesses that have been linked to air pollution.

This research, the first of its kind in economic valuation, focused on previously hospitalized patients for illnesses that have been linked to air pollution. This study provides the most comprehensive COI estimates that include in-hospital and post-hospital costs to date. It also provides an estimate of individual's WTP to prevent future hospitalization. The WTP estimates seem significant. For example, avoiding a one-day hospitalization event is valued at approximately \$1,600. The societal costs of a hospitalization ranged between \$4,800 per day for acute respiratory illness, to \$5,100 per day for chronic respiratory illness. The best estimate for a cardiovascular illness was \$6,800 per day. The results will be used for estimating the economic value of reducing air pollution related health effects.

7. "Characterizing the Range of Children's Pollutant Exposure During School Bus Commutes," University of California, Riverside, \$449,503, Contract No. 00-322

A previous Air Resources Board (ARB)-sponsored study of in-vehicle concentrations (Rodes et al., 1998) indicated that proximity to diesel-fueled vehicles results in high concentrations of in-vehicle fine particles and black carbon. Because most California school buses are diesel-powered, significant numbers of school children are potentially exposed to high concentrations of diesel particles and other pollutants during their commutes by bus and during their time spent in proximity to running and idling buses. Children are especially susceptible to air pollution because of their high inhalation rates relative to body mass, high activity levels, greater time spent outdoors, narrower lung airways, immature immune systems, and rapid growth.

The objective of this study was to characterize the school bus commute exposures experienced by children while riding on buses, waiting at bus stops, or waiting near idling buses during loading, with an emphasis on those conditions leading to high exposures. It was desired to also cover a range of commute scenarios, sampling locations (such as bus stops and loading areas), and fuel types. All important vehicle exhaust pollutants were to be measured. Many of these measurements were to be made in real-time to help determine which specific factors and events result in the highest concentrations and what the duration of those peak concentrations are.

Real-time and integrated measurements of pollutant concentrations were made inside school buses along actual bus routes in Los Angeles. These results showed the importance of efforts to encourage the replacement of older conventional diesel school buses with newer buses, preferably powered by non-diesel fuels or with control technologies such as particle traps.

8. "Refinement and Demonstration of a New Indoor Continuous Nitrogen Dioxide Monitor," Batelle, \$89,947, Contract No. 99-327

Accurate, short-term measurements of indoor nitrogen dioxide (NO<sub>2</sub>) are needed because a significant portion of NO<sub>2</sub> exposure is attributable to indoor sources, such as gas stoves and furnaces. Under previous Air Resources Board funding, investigators developed a real-time, portable indoor NO<sub>2</sub> monitor based on an electrochemical sensor. The monitor can accurately measure both NO<sub>2</sub> and nitrous acid.

The objectives of this project are to improve the monitors developed under the previous contract and document the performance of the enhanced monitors in California homes at elevated NO<sub>2</sub> levels. Investigators installed a new amplification circuit to reduce noise and improve accuracy at low concentrations, streamlined data reduction, built an additional monitor, and trained ARB staff on monitor use. ARB staff calibrated and evaluated the monitors in a laboratory setting, then evaluated the monitors in a California residence under conditions of typical and high concentrations of NO<sub>2</sub>. ARB staff gained valuable experience operating the monitors and found their overall performance to be very good. The portable monitors will be used in future field studies to measure Californians' exposures to NO<sub>2</sub>, and to help quantify the relative contributions of indoor and outdoor sources to those exposures.

9. "Validation of Concentrations Estimated from Air Dispersion Modeling for Source-Receptor Distances of Less Than 100 Meters," University of California, Riverside, \$150,000, Contract No. 99-319

People may live or work very near sources of toxic and criteria pollutant emissions, such as dry cleaners, chrome plating plants, and automotive repair facilities. As a result, there is a regulatory need to estimate both short-term and annual average pollutant concentrations and assess the associated risks. However, existing dispersion models were developed using experimental data that did not include any measurements for source-to-receptor distances less than 100 meters and observations of dispersion in the presence of common obstacles, such as buildings, are limited. Thus, concentration estimates made with those models for source-to-receptor distances of less than 100 meters are extrapolations of the experimental results.

This project provided near-source experimental data for model evaluation and a proposed new model formulation for predicting pollutant concentrations in close proximity to emission sources and in the presence of obstacles, such as buildings, that seriously influence dispersion. Investigators conducted a series of field experiments and corresponding model evaluations representing progressively more complex situations. These range from the simplest scenario, flat terrain and an absence of obstacles, to the most complex, which included realistic source configurations and surroundings, such as

buildings. Results from this study provide the experimental evidence, evaluations, and a proposed methodology to improve our understanding and capability to model near-source exposures for environments typical of the settings where toxic emissions actually occur.

10. "On-Vehicle Emissions Testing System," Analytical Engineering, Inc., \$75,020, Contract No. 00-329

This contract was ARB's contribution to the U.S. EPA's efforts to develop an improved capability for onboard, real-time exhaust emission measurements. EPA had contracted with AEI for a multi-faceted development project called Simple Portable On-Vehicle Testing (SPOT), which had produced a prototype device. EPA is developing the technology to support an emission inventory model that is based in part on in-use emission data and to enable in-use compliance monitoring, especially for heavy-duty diesel trucks.

ARB agreed to support two improvements to the prototype: (1) improve the flow measurement device by reducing its size (to adapt it to small exhaust pipes) and improve its ease of calibration and signal-to noise ratio, and (2) develop a proportional sampler that would be needed to incorporate a PM measurement technology into the SPOT system. In addition, ARB agreed to purchase a SPOT unit (without PM capability) from AEI for its own experimental uses.

The improvements to the flow measurement device have been completed satisfactorily, and ARB has received the SPOT unit. The ARB cancelled the work on a proportional sampler because EPA did not have definitive plans on how to incorporate PM measurement into SPOT. This reduced the budget from \$100,000 to \$75,000.

### **Interim Report**

11. "Incidence of Malfunctions and Tampering in Heavy-Duty Diesel Vehicles," University of California, Riverside, \$199,103, Contract No. 01-340

The objective of this project is to provide new estimates of the incidence of certain types of malfunctions and tampering (collectively, "faults") that can increase PM or NO<sub>x</sub> emissions from on-road heavy-duty diesel vehicles. ARB wants information on the incidence of faults to improve the emissions inventories for diesel vehicles and to design an inspection-and-maintenance program.

The work plan calls for the contractor to obtain data related to fault incidence from several sources: a literature review; EPA data; warranty information; data from the ARB's heavy-duty on-road inspection program; new surveys of records at repair facilities and fleet maintenance operations; and road-side inspections during regular field activities of the Enforcement Division.

At the suggestion of the Research Screening Committee, the project was split into separable phases. Phase 1 was conducted to determine (1) the practicality of obtaining data from the various sources and (2) the ability to estimate the incidence of faults from

the obtainable data. Phase 1 was a pilot study in which the contractor attempted to collect small samples of data from the various sources and to create a method of analysis that should yield the desired estimates of incidence. Phase 2--the conduct of the full work plan for the project--is to occur only if ARB and the RSC agree that the results of Phase 1 indicate that Phase 2 is likely to provide estimates superior to the existing estimates of fault incidence.

The ARB staff does not see sufficient evidence from Phase 1 to merit proceeding with Phase 2. The contractor was not able to acquire data from some of the planned sources. Some of the data that were obtained could not be used to derive estimates in the correct metric with any estimate of precision. In summary, it is not apparent that conducting Phase 2 would lead to estimates of incidence that would be notably different from the current values and more defensible.

### **Other Business**

#### 12. "Strategic Plan for Research, 2001 to 2010, Update"

The Strategic Plan for Research serves as the ARB's roadmap for research funding through 2010. Specifically, the purpose of the Plan is to lay out the research needs of the ARB's regulatory programs and to identify key research activities the ARB expects to pursue over the next several years. The Plan is intended to inform the public, provide stakeholders and research funding organizations with targets for possible collaboration with the ARB, and inform university researchers and private consultants about the ARB's major research needs. The Plan is being reviewed to ensure that environmental justice and global warming issues will be adequately addressed in the future.

#### 13. "Vulnerable Populations Research Plan, 2003 Update"

The Air Resources Board's (ARB) Vulnerable Populations Research Program (VPRP) provides a programmatic structure and resources to address issues of vulnerability to the effects of air pollution. This program represents the first focused effort to ensure the protection of all of California's citizens, including sensitive subpopulations, from the adverse effects of air pollution. To implement the Program, the ARB is developing a long-range Vulnerable Populations Program Research Plan which presents a vision for future research development as well as highlighting the coordinated and collaborative research efforts of other health and environmental agencies on issues of sensitive populations. Included in the plan are activities related to better assessment of air pollution exposures which ultimately will benefit the ARB's Environmental Justice Program. The determination of health impacts on sensitive subgroups is crucial to aid the ARB in developing regulations to protect all citizens of California.